Detection of unrecorded environmental challenges and genetic determinism of resilience in lambs

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Resilient animals are capable of remaining productive under different environmental challenges. Rearing in increasingly heterogeneous environmental conditions increases the need of selecting resilient animals. Under normal productive rearing conditions, challenge events are sometimes unrecorded and from unknown source. Therefore, being able to identify periods in which a potential environmental challenge occurred provides an opportunity to quantify variability among animals and select those more resilient. In this study, we present a simple and practical data-driven approach to identify unrecorded environmental challenges to evaluate genetic determinism of resilience to these events. A total of 951 Romane male lambs were phenotyped for feed intake over an 8-year period (from 2009 to 2016) at the INRAE La Sapinière experimental farm. Feed intake was automatically recorded using automatic concentrate feeders during an 8-week period each year. A total of 51,832 daily feed intake (DFI) records were available. We fitted a mixture of two Gaussian distributions on the natural log-transformed coefficient of variation (CV) of DFI and computed the posterior probabilities of pertaining to the second component (high values of CV) for each day. Consequently, we were able to differentiate 'low CV days' (with low probability of having a high CV) and 'high CV days', with increased variability in DFI probably due to the occurrence of an environmental challenge. These probabilities were included as a covariate in a reaction norm animal model to evaluate genetic determinism of resilience to unrecorded environmental challenges. Variance components were estimated using Gibbs sampling and REML. The genetic correlation between the level and sensitivity to inferred environmental challenge was -0.73±0.05, showing that a hypothetical selection for increased DFI would result in decreased environmental sensitivity (increased resilience). In the frame of H2020 project SMARTER no. 772787.

SMARTER EU project: SMAll RuminanTs breeding for efficiency and resilience

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In the frame of H2020 project SMARTER no. 772787, we are developing and will deploy innovative strategies to improve Resilience and Efficiency (R&E) traits for sheep and goat. Several R&E traits including feed efficiency, mobilisation of body reserves, disease resistance, survival and welfare are being investigated. Experimental populations are used to identify new predictors of these R&E traits and the trade-offs the animal faces to overcome external challenges. We aim to characterise the underlying genetic and genomic variability governing these R&E traits and trade-offs. The genotype-by-environment interactions (G×E) of R&E traits will be estimated in large commercial populations. The adaptation genes will be also characterised comparing under-utilised breeds that are well-adapted to their environments. New methods of genetic analysis and genomic selection are proposed to take into account R&E traits and G×E, aiming at estimating accurate R&E genomic predictions in different environments across different populations. We will improve R&E predictions by performing genomic selection across countries thanks to a new cooperative EU and international initiative in this project. We are also developing new models at both animal and farm levels to predict trade-offs between productivity and R&E traits. Finally, we will propose new breeding strategies that utilise R&E traits and trade-offs and that also balance economic, social and environmental challenges from their implementation.

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